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Five Southern California Oaks: identification and postfire management

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Cover: (Left) This 60-foot tall coast live oak in Riverside County was heavily burned in the Soboba Fire in 1974. *(Right)* The same coast live oak 5 years later has made an amazing crown foliage recovery. It is an extremely fire-tolerant species.

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Oak trees are found on at least 20 million acres (8 million ha) in California. They comprise more than 9 million acres (3.6 million ha) of open woodland, are mixed with other evergreen broadleaf and coniferous trees in the mountains of California, and are also prominent members of the chaparral community. Although their current value as a timber resource is limited, oak trees provide a tremendous potential source of biomass for energy production and wood products. Perhaps even more significant are their roles in stabilizing soil for watersheds, and in providing wildlife habitats and forests for recreation and esthetic values.

All California oak trees are subject to partial or total killing by wildfire. Current efforts in southern California to use prescribed burning in oak stands to reduce fire hazard necessitate knowledge of the effect of fire on tree damage and survival. Effective management of oaks, therefore, requires an understanding of their response to fire.

Oak species vary in their susceptibility to fire. Individual species must be correctly identified before effective management plans can be made. Large, old trees damaged by fire should not be removed if crown recovery is possible. Some oak species are difficult to identify, especially when the trees are heavily charred and the leaves and acorns have been consumed.

This report provides a guide to identifying five of the prominent species of southern California oaks—coast live

oak, interior live oak, California black oak, canyon live oak, and California scrub oak. It provides specific information for the identification of each of the five species; assesses fire damage for the trees on the basis of species, diameter-at-breast-height (d.b.h.), and degree of trunk charring; and, briefly outlines postfire management alternatives for fire-damaged trees.

IDENTIFICATION OF OAK SPECIES

Oaks native to California can be divided into three subgenera: white oaks (*Quercus*), intermediate oaks (*Protobalanus*), and black or red oaks (*Erythrobalanus*). The 15 native species, their common names, their subgenera (Tucker 1980) and growth habit are:

White oaks

Blue oak (<i>Q. douglasii</i> Hook. & Arn.)	Tree
Scrub oak (California scrub oak) ¹ (<i>Q. dumosa</i> Nutt.)	Shrub
Leather oak (<i>Q. durata</i> Jeps.)	Shrub
Engelmann oak (<i>Q. engelmannii</i> Greene)	Tree
Oregon oak (Oregon white oak) ¹ (<i>Q. garryana</i> Dougl.)	Tree
Valley oak (<i>Q. lobata</i> Nee)	Tree
Deer oak (<i>Q. sadleriana</i> R.Br. Campst.)	Shrub
No common name (<i>Q. turbinella</i> ssp. <i>californica</i> Tucker)	Shrub

Intermediate oaks		
Canyon live oak (<i>Q. chrysolepis</i> Liebm.)		Tree
Dunn oak (<i>Q. dunnii</i> Kell.)		Shrub
Island oak (island live oak) ¹ (<i>Q. tomentella</i> Engelm.)		Small tree
Huckleberry oak (<i>Q. vaccinifolia</i> Kell.)		Shrub
Black or red oaks		
Coast live oak (<i>Q. agrifolia</i> Née)		Tree
California black oak (<i>Q. kelloggii</i> Newb.)		Tree
Interior live oak (<i>Q. wislizenii</i> A. DC.)		Tree

¹ Common names as listed in Little (1979).

Identifying some oak species is easy because of one or more unique characteristics, but other species are extremely difficult to identify because of diversity in the size and shape of the leaves, acorns, and trees themselves. Identification is further complicated by numerous varieties and hybridization among species. This is especially true for the shrubby species such as California scrub oak. Precise identification of shrub-sized oaks is probably unnecessary from a practical management basis, however, because small trees—those with stems less than 3 to 6 inches (7.6 to 15.2 cm) d.b.h.—will almost always be killed to the ground except by a light ground fire.

Most oaks have one or two key features that separate them from other species. These features are augmented in this guide by a detailed description of the bark, which is especially valuable for identifying burned trees when the leaves and acorns are missing. But because even bark varies within

species with age, more than one illustration is provided to show some of its natural variation.

Three identification keys for leaf, acorn, and bark for two tree sizes are provided for the initial screening of the five species of southern California oaks. Once a species is tentatively identified, a more complete description is given in the next section, which includes a general description of the tree plus a detailed description of the leaves, acorns, and bark.

Leaf Key

- A. Leaves conspicuously lobed, deciduous, leaf blade 2 to 8 inches (5.1 to 20.3 cm) long California black oak.
- AA. Leaves inconspicuously lobed to entire, evergreen, generally 1 to 3 inches (2.5 to 7.6 cm) long.
 - B. Leaves cupped downward, tufts of hairs on underside of leaf at the junction of the mid- and lateral veins Coast live oak.
 - BB. Leaves not cupped.
 - C. Leaves shiny, pale green below, hairless Interior live oak.
 - CC. Leaves not shiny, gray-green below.
 - D. Leaves with minute but conspicuous golden hairs beneath (when young), or gray-green or whitish beneath; lateral veins six or (usually) more on either side of midvein Canyon live oak.
 - DD. Leaves never with golden hairs beneath; gray hairs below, never conspicuous; lateral veins commonly four or five (sometimes six) on either side of midvein California scrub oak.

Acorn Key

- A. Inner surface of acorn shell (not the cup) densely to moderately woolly.
 - B. Walls of cup often very thick; often covered with minute, golden hairs Canyon live oak.
 - BB Walls of cup thin, tapering to a very thin upper margin; never covered with minute, golden hairs.
 - C. Acorns maturing in 1 year, that is, fully developed acorns on this year's growthCoast live oak
 - CC Acorns maturing in 2 years, that is, they are on last year's growth.
 - D. Nut (without cup) slender-ovate, tapering to apex Interior live oak.
 - DD. Nut (without cup) oblong, rounded at apex California black oak.
- AA. Inner surface of acorn shell smooth, not woolly California scrub oak.

Bark Keys

Trees less than 6 inches (15.2 cm) d.b.h.

- A. Surface smooth.
 - B. Light gray Coast live oak.
 - BB. Dark gray Interior live oak.
- AA. Surface rough.
 - C. No loose bark; shallow, vertical furrows California black oak.
 - CC Loose bark surface.
 - D. Surface flakes irregularly shaped, no distinct furrow pattern, light gray California scrub oak.
 - DD. Surface flakes more or less rectangularly shaped, some vertical furrows Canyon live oak.

Trees larger than 6 inches (15.2 cm) d.b.h.

- A. Surface smooth to furrowed, no loose surface bark.
 - B. Furrow pattern (deep in old trees) divides bark into small black to reddish-brown, rectangular blocks California black
- BB. Furrow pattern vertical.
 - C. Surface smooth to wide-spreading, long, vertical furrows with light gray wide ridges between furrows Coast live oak.
 - CC. Surface smooth to shallow, short vertical furrows; dark gray ridges between furrows Interior live oak.
- AA. Surface furrowed; loose to somewhat firm outer bark.
 - D. Mostly irregularly shaped, loose flaky bark; no definite furrow pattern; d.b.h. does not exceed 10 inches (25.4 cm) California scrub oak.
 - DD. Mostly narrow, vertical furrows; loose to more or less firm bark on ridges between furrows Canyon live oak.

FIVE SOUTHERN CALIFORNIA OAKS

Detailed descriptions of five, prominent southern California oaks are given in the following sections. At this time, comparable, descriptive information is not available for all five species. Much of the following information was obtained from Jepson (1909), Munz and Keck (1959), and Sudworth and others (1967).

Coast Live Oak

General description—*Height*: usually 20 to 40 ft (6 to 12 m), up to 80 ft. *D.b.h.*: 1 to 4 ft (0.3 to 1.2 m). *Age*: long-lived, 250 years plus. *Crown* (open grown): broad, dome-shaped, dense; may reach the ground (*fig. 1*); width up to two times height. *Crown* (closed stand): crown width may be less than one-half crown height (*fig. 2*). *Trunk* (open grown): short, 4 to 8 ft (1.2 to 2.4 m) long, forking into large, wide-spreading branches extending outward horizontally. *Trunk* (closed stand): clear trunk may extend 20 ft (6.2 m) before

separating into two or three main branches extending upward at sharp angle. *Tolerance*: tolerant of shade throughout life. *Wood*: hard, heavy, fine-grained, but brittle and poor for timber as wood checks and warps badly. *Present uses*: esthetic and wildlife values, fuel, and charcoal.

Distribution—*Range*: coast ranges from Sonoma County to Lower California (*fig. 3*). *Elevation*: below 3000 ft (900 m) in Sonoma County, up to 5000 ft (1500 m) in San Diego County. *Site*: common on valley floors, not-too-dry, fertile slopes; often forms a narrow riparian woodland. *Associated species*: may form pure stands, but often associated with interior live oak, California sycamore (*Platanus racemosa* Nutt.), white alder (*Alnus rhombifolia* Nutt.), California bay (*Umbellularia californica* [Hook & Arn.] Nutt.). *Ground cover*: often sparse, but may have dense cover of shade-loving broad-leaved, herbaceous plants (Pacific poison oak [*Rhus diversiloba* T. & G.], skunkbush sumac [*Rhus trilobata* Nutt.], nettle [*Urtica holosericea* Nutt.]); grass sparse in dense stands but some present under open-grown trees. *Litter*: thick (5 inches [12.7 cm] or more) oak leaf layer common.

Leaves—*Persistence*: evergreen, drop in spring after new leaves formed. *Size*: 0.8 to 2.5 inches (2.0 to 6.4 cm) long, 0.5 to 1.5 inches (1.3 to 3.8 cm) wide. *Shape*: oblong to ovoid, usually strongly cupped downward (*fig. 4*), margins usually



Figure 1—Coast Live Oak: Open-grown trees have a broad, dense crown that may reach the ground. Usually, they have a single trunk with wide-spreading branches.



Figure 2—Coast Live Oak: Tree crowns in a closed stand may be narrow and irregular and the trunk maybe clear for 15 to 20 ft (4.5 to 6.0 m) with major branches rising at an acute angle.

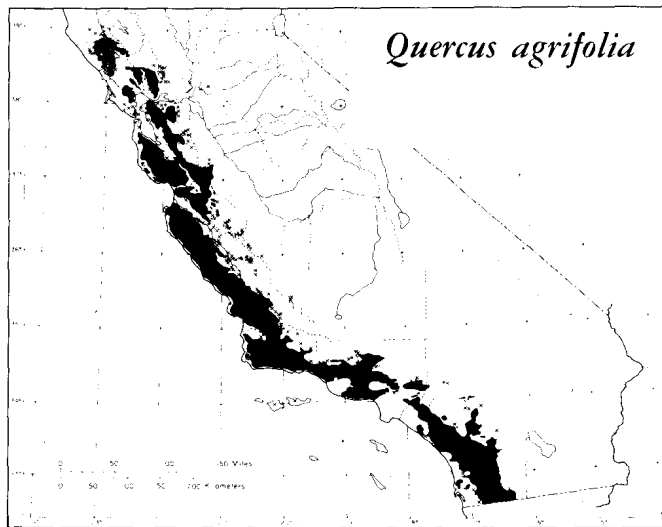


Figure 3—Coast Live Oak: The species is found in the coastal mountains and valleys from central to Lower California. (■ Group of stands more than 2 mi [3.2 km] across; x Stands less than 2 mi [3.2 km] across or of unknown size) (Griffin and Critchfield 1972).

spine-tipped but sometimes entire. *Surface* (upper): dark, shiny green, hairless to scattered star-shaped hairs. *Surface* (lower): paler green, somewhat shiny (*fig. 5*), tufts of hairs at junction of main and lateral veins.

Acorns—*Development period*: one season. *Size*: 1.0 to 1.5 inches (2.5 to 3.8 cm) long, 0.4 to 0.6 inch (1.0 to 1.5 cm) wide (*figs. 6 and 7*). *Shape*: slender, pointed, sometimes slightly curved. *Color*: tan. *Surface*: hairless.

Cups—*Size*: 0.3 to 0.5 inch (0.8 to 1.3 cm) deep, 0.4 to 0.6 inch (1.0 to 1.5 cm) across. *Shape*: cone-shaped. *Surface*: inside is silky or woolly. *Scales*: brown, thin edges turned in, minutely hairy. *Wall*: thin, tapering to thin upper margin.

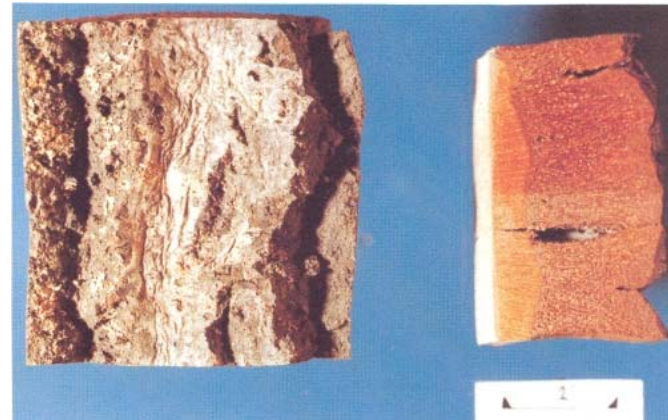
Bark unburned—*Texture*: surface of young trees and older branches smooth (*fig. 8*); as trees mature (*figs. 9 and 10*), wide and often deep furrows develop that may extend up and down trunk; furrows usually separated by wide, smooth ridges; bark surface hard and firm with no loose outer, flaky material (unless previously damaged by fire). Considerable variation in bark texture, however (*fig. 11*). *Color*: both young and smooth mature bark light gray; rough surface furrows dark gray. *Thickness*: extremely thick bark comprised mostly of reddish inner bark. Live bark may extend to surface; outer bark thin and unevenly distributed over surface with greatest amount associated with edge of furrows.



Coast Live Oak: **Figure 4** (left)—The leaves are evergreen, dark, shiny green above, and paler green below. The species is the only California oak with leaves that are strongly cupped downward. **Figure 5** (above)—The underside of a typical leaf shows hairs sparse, with clusters of hairs where lateral veins join the midvein.



Coast Live Oak: **Figure 6** (above)—Acorns of this species are 1.0 to 1.5 inches (2.5 to 3.8 cm) long, slender, and more sharply pointed than those of interior live oak. Cup walls are thin and taper to a very thin upper margin. **Figure 7** (right)—Acorns mature in one growing season and are either alone or in clusters. Often they are well hidden by the dark green, cupped leaves.



Coast Live Oak: **Figure 8** (above left)—The bark of young, 3-inch (7.6-cm) diameter stems is smooth textured and light gray in color. The inner bark is about 0.1 inch (0.3 cm) thick and there is little or no dead outer bark. **Figure 9** (left)—The bark of mature trees with 6-inch (15.2-cm) diameters has a range of texture from smooth to furrowed. The inner bark is about 0.5 inch (1.3 cm) thick and there is little dead outer bark. **Figure 10** (above)—The bark of trees with 12-inch (30.5-cm) diameters has a range of surface texture from mostly smooth to wide furrows with tapering sides. The inner bark is about 1.0 inch (2.5 cm) thick, with little dead outer bark.



Coast Live Oak: **Figure 11** (above)—The bark occasionally has narrow, steep-sided furrows (top). Young, mature bark is mostly smooth (bottom). **Figure 12** (right)—Burned bark, even when heavily charred, has only slight reduction in bark thickness. Surface features remain mostly unchanged. Vertical and horizontal cracks soon develop, exposing light reddish or white tissue underneath the damaged bark.

Bark burned: Even when entire trunk and all branches completely charred, reduction in bark thickness usually minor (*fig. 12*). Although charred, pattern of furrows and ridges remains. As burned bark dries, it separates into rectangular-like pieces separated by fine cracks. Even where heavily charred, damage usually extends only 0.5 to 0.8 inch (1.3 to 1.9 cm) into bark.

Interior Live Oak

General description—*Height:* 30 to 75 ft (10 to 22 m) tall, but sometimes only a shrub 8 to 10 ft tall. *D.b.h.:* 1 to 3 ft (0.3 to 0.9 m). *Longevity:* unknown, but at least 150 to 200 years when protected from fire. (Root system, like that of other oaks, may be several crown generations old.) *Crown* (open-grown): full, dense, rounded, with foliage to ground; not broad or with large limbs like coast live oak (*fig. 13*). *Crown* (closed stand): often irregular shaped, longer than wide. *Trunk* (open stand): branching begins low on trunk, branches fairly large and somewhat spreading. *Trunk* (closed stand): large trees may have straight bole 15 to 20 ft (4.6 to 6.1 m) long before separating into two or three main boles (*fig. 14*). Smaller trees often grow as clumps of several smaller boles (*fig. 13*). *Toler-*

ance: very tolerant of shade (Sudworth and others 1967); probably less tolerant in later life. *Wood:* similar to coast live oak, has thick, whitish sapwood. *Present uses:* fuelwood, wildlife, and watershed values.

Distribution—*Range:* Cascades in Siskiyou County south to Lower California, lower slopes of Sierra Nevada and inner Coast Ranges (*fig. 15*). *Elevation:* in northern part of range, from 1000 to 2000 ft (300 to 600 m), in southern California up to 6200 ft (1300 m). *Site:* wide variety of sites including valleys and foothills in coastal mountains but away from coast side, and especially foothills and broad alluvial banks of rivers of Sierra Nevada. In southern California, on sides of mountains, as riparian zone in chaparral, and as dense, shrubby thickets in mixed-conifer forest. *Associated species:* occasionally in pure stands, but more often mixed with blue oak, coast live oak, canyon live oak, digger pine (*Pinus sabiniana* Dougl.), scrub oak, and various chaparral species. *Ground cover:* dense tree canopy inhibits grass and other herbaceous development. *Litter:* thick litter develops under dense canopy.

Leaves—*Persistence:* evergreen, last 2 years. *Size:* 0.8 to 4.0 inches (1.9 to 10.2 cm) long (*fig. 16*). *Petiole:* 0.1 to 0.8 inch (0.3 to 1.9 cm) long. *Shape:* elliptic to oblong; leaf margins entire to spine-toothed; flat, never curled. *Surface:* hairless and shiny above and below, dark green above and pale green underneath.



Figure 13—Interior Live Oak: Open-grown trees have full, dense, rounded crowns that reach the ground. Trees are often multi-stemmed and less than 15 inches (38 cm) d.b.h.

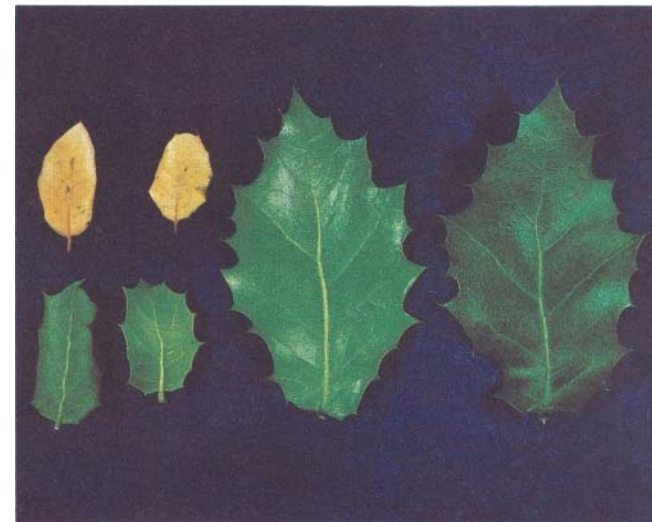
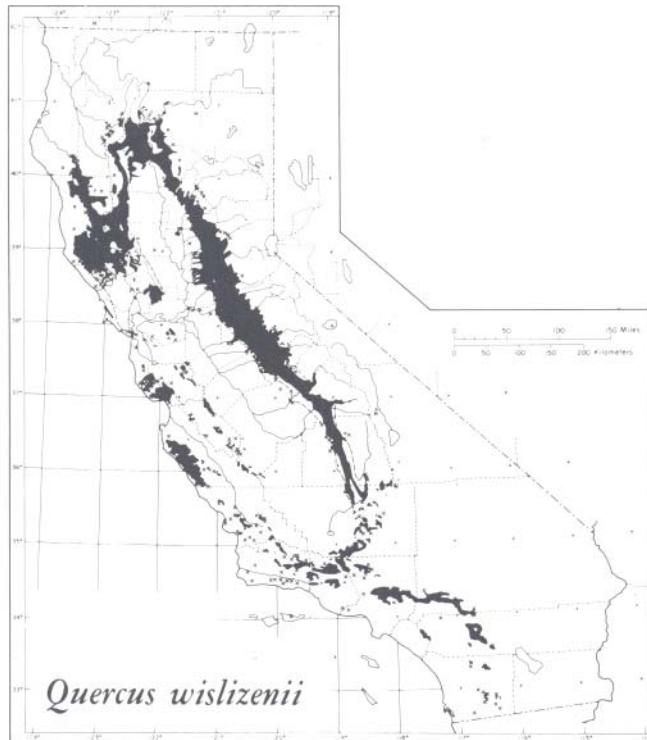


Acorns— *Development period*: mature second year. *Size*: 0.8 to 1.5 inches (1.9 to 3.8 cm) long, 0.3 to 0.5 inch (0.7 to 1.3 cm) wide (*figs. 17 and 18*). *Shape*: slender, cylindrical to conical. *Surface*: generally hairless. *Color*: tan when mature, often with thin, darker longitudinal stripes.

Cups—*Size*: 0.5 to 0.8 inch (1.3 to 1.9 cm) long, 0.5 to 0.6 inch (1.3 to 1.6 cm) wide. *Shape*: cup-shaped. *Scales*: thin, brownish-colored, covered with short downy hairs, fringed with hairs on scale margins. *Wall*: thin, tapering to thin upper margin.

Bark unburned—*Texture*: generally smooth in stems up to 6 inches (15.2 cm) d.b.h. although bark may be rough at base of tree (*figs. 19 and 20*). On old trees, shallow fissures develop separated by narrow ridges (*fig. 21*). Bark surface often covered with lichens (*fig. 22*). Surface of outer bark hard with no loose, flaky bark, although surface may become rough on large, old trees (*fig. 23*). *Color*: gray to dark gray, generally darker than coast live oak. *Thickness*: composed mostly of live inner bark, about one-third as thick as coast live oak.

Figure 14—Interior Live Oak: Tree crowns in a closed stand are often irregular and, for large trees, are much taller than they are wide, with trunks clear of branches for 15 to 20 ft (4.6 to 6.1 m).



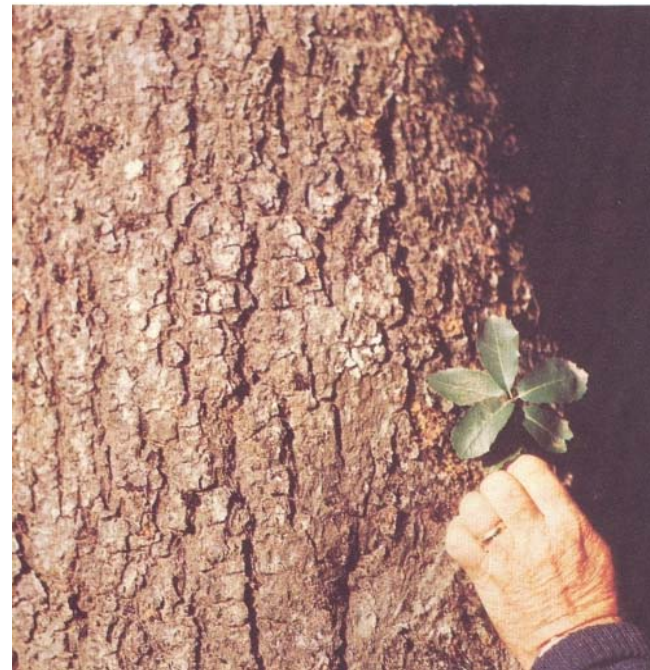
Interior Live Oak: **Figure 15** (left)—This species ranges from Siskiyou County in northern California to Lower California. It is common in coastal valleys, foothills, and mountains, and in foothills and along rivers in the western Sierra Nevada. (■ Group of stands more than 2 mi [3.2 km] across; x Stands less than 2 mi [3.2 km] across or of unknown size) (Griffin and Critchfield 1972) **Figure 16** (above) —Leaves are evergreen, dark, shiny green above, pale, shiny green, and hairless below, with margins varying from smooth to spiny-toothed.



Interior Live Oak: **Figure 17** (above)—Acorns are 0.8 to 1.5 inches (1.9 to 3.8 cm) long, slender, two or more times longer than wide with darker, longitudinal stripes when mature. The cup has a distinct stem. **Figure 18** (right)—Acorns mature in two growing seasons. Cups, light tan, enclose about one-third of the mature acorn.



Interior Live Oak: **Figure 19** (above left)—Bark of young 3-inch (7.6-cm) diameter stems has a smooth, dark gray surface. The bark is about 0.1 inch (0.3 cm) thick and is mostly living, inner bark with a thin covering of dead, outer bark. **Figure 20** (left)—Bark of young 6-inch (15.2-cm) diameter trees is mostly smooth textured, but older trees may have shallow furrows. The bark is about 0.2 inch (0.5 cm) thick and is mostly live, inner bark. **Figure 21** (above)—Bark surface texture of 12-inch (30.5-cm) diameter trees ranges from almost smooth to well-developed shallow, narrow furrows. The bark is about 0.3 inch (0.8 cm) thick with a small amount of dead bark forming the ridges between the furrows.



Interior Live Oak: **Figure 22** (left)—The surface of trees with smooth outer bark is often covered with a dense array of colorful lichens ranging from gray to yellow and red. Although found on most oaks, lichens are especially common on interior live oak. **Figure 23** (above)—Large, old trees may have rather deeply furrowed bark with some loose, dead outer bark. Lichens are present but are not as thick as on smooth-surfaced trees.



Interior Live Oak: **Figure 24** (above)—The heavily charred bark of a smooth-surfaced tree trunk retains a smooth surface. Reduction of the bark is minimal. Vertical cracks develop as the bark dries, exposing reddish-brown damaged tissue. **Figure 25** (right)—The original pattern of furrows remains clearly evident even in heavily charred bark. Only a small amount of the bark surface is removed even during heavy burning.



Bark burned: though smooth outer bark chars, usually not much reduction of bark thickness; rarely burns through to wood (*figs. 24 and 25*). Even for large trees, bark provides only moderate protection to cambium from heat damage. In young stems, heat-damaged bark may turn dark reddish-brown (*fig. 26*). Surface of healthy, young bark when scraped off reveals green layer of chlorophyll-containing live bark. Damaged bark hard and tan under surface.

California Black Oak

General description: —*Height:* usually 30 to 80 ft (9 to 25 m) and, occasionally, more than 100 ft. *D.b.h.:* 1.0 to 4.5 ft (0.3 to 1.4 m). *Age:* up to 325 years, but probably less than 350 years. *Crown* (open grown): graceful, broad, rounded, near ground but rarely touching (*fig. 27*). *Crown* (closed stand): narrow, slender at top of young trees, irregularly broader in old trees. *Trunk:* if open grown, several forks common; if closed

Figure 26—Interior Live Oak: Cambium damage to young stems with smooth, gray bark may be indicated by a reddish tint on the bark. The damaged bark is very hard. Undamaged bark is green immediately under the surface.

grown, often straight, sometimes leaning or curving; trunk free of branches for 20 to 40 feet (6 to 12 m) (*fig. 28*); many old trees have decayed, hollow trunks. *Tolerance*: tolerates moderate shade in early life, needs full overhead sunlight for good growth. *Wood*: fine-grained, porous, brittle; heavy, large rays; strong tannin odor. *Present uses*: fuel, wildlife, and esthetic values; limited use for lumber and other wood products.

Distribution— *Range*: San Diego north through Sierra Nevada and Coast Ranges to Eugene, Oregon; also along eastern base of Sierra Nevada (*fig. 29*). *Elevation*: 1000 to 8000 ft (300 to 2400 m), 4000 to 9000 ft (1200 to 2700 m) in southern California. *Site*: mountain slopes, benches and coves, canyon bottoms, lower sidehills, and upper foothill slopes. *Associated species*: California bay, western dogwood (*Cornus occidentalis* [Ton. & Gray] Cov.), interior live oak, ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.), and components of mixed-evergreen, mixed-conifer, ponderosa pine forests and oak woodlands. *Ground cover*: woody shrubs with various herbaceous plants including some grass under open-grown trees.

Figure 27—California Black Oak: Open-grown trees have a graceful, broad, rounded crown. The foliage is fairly open, the crown has an airy appearance and seldom reaches the ground.

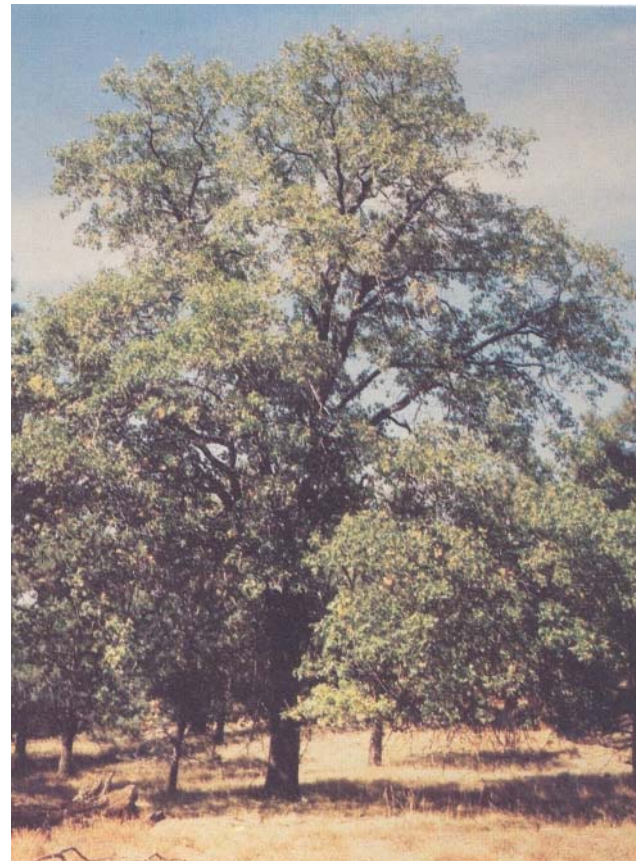




Figure 28—California Black Oak: In a closed stand, the crowns are irregular and generally limited to the top one-half to one-third of the tree. The trees are mostly single- or double-trunked.

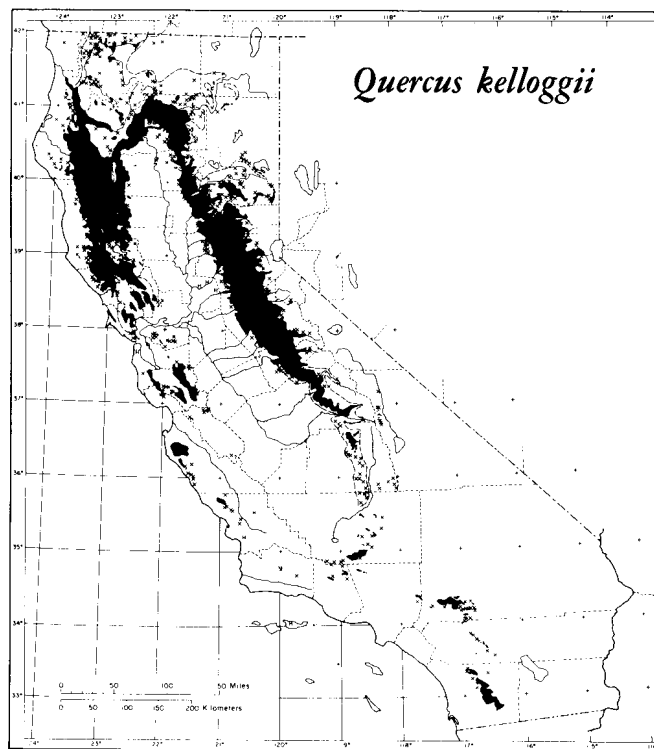


Figure 29—California Black Oak: The species ranges from Eugene, Oregon, south through the Sierra Nevada and Coast Ranges to San Diego County. (■ Group of stands more than 2 mi [3.2 km] across; x Stands less than 2 mi [3.2 km] across or of unknown size) (Griffin and Critchfield 1972).

Leaves—*Persistence*: deciduous. *Size*: 2.0 to 8.0 inches (5.1 to 20.3 cm) long. *Shape*: elliptical, but variable; deeply lobed into three main divisions on each side, one to four coarse bristled teeth on each lobe (fig. 30). *Surface*: bright green top, mostly without hairs; pale green beneath with a sparse to dense mat of star-shaped hairs. *Petiole*: 1.0 to 2.0 inches (2.5 to 5.1 cm) long.

Acorns—*Development period*: 2 years. *Size*: 0.8 to 1.3 inches (1.9 to 3.2 cm) long, 0.5 to 0.8 inch (1.3 to 1.9 cm) wide (fig. 31). *Shape*: oblong, rounded at apex. *Color*: pale chestnut-colored when mature. *Surface*: covered with fine hairs; inside of acorn shell hairy. *Productivity*: variable, abundant crops produced every 2 to 4 years, above average every 7 to 8 years in a closed stand; acorns prominent, often in clusters of two to four (fig. 32). *Germination*: best in shade on exposed mineral soil.

Cups—*Size*: 0.6 to 1.0 inch (1.5 to 2.5 cm) deep, 0.8 to 1.1 inch (2.0 to 2.8 cm) wide. *Shape*: cup-shaped, enclosing almost one-half of the acorn. *Surface*: minute hairs within cup. *Scales*: thin, often thickened at base, somewhat ragged on margins, brown when mature. *Wall*: thin, tapering to thin upper margin.

Bark unburned—*Texture*: young, 3-inch (7.6-cm) diameter stems mostly smooth (fig. 33), some fissuring as grow